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Pollutant swapping: greenhouse gas emissions from wetland systems constructed to mitigate agricultural pollution

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Diffuse (non-point) water pollution from agricultural land continues to challenge water quality management, requiring the adoption of new land management practices. The use of constructed agricultural wetlands is one such practice, designed to trap multiple pollutants mobilised by rainfall prior to them reaching receiving water. Through capturing and storing pollutants in bottom sediments, it could be hypothesised that the abundance of nutrients stored in the anoxic conditions commonly found in these zones may lead to pollutant swapping. Under these circumstances, trapped material may undergo biogeochemical cycling to change chemical or physical form and thereby become more problematic or mobile within the environment. Thus, constructed agricultural wetlands designed to mitigate against one form of pollution may in fact offset the created benefits by 'swapping' this pollution into other forms and pathways, such as through release to the atmosphere.

Pollutant swapping to the atmosphere has been noted in analogous wetland systems designed to treat municipal and industrial wastewaters, with significant fluxes of CO₂, CH₄ and N₂O being recorded in some cases. However the small size, low level of engineering and variable nutrient/sediment inputs which are features of constructed agricultural wetlands, means that this knowledge is not directly transferable. Therefore, more information is required when assessing whether a wetland's potential to act as hotspot for pollution swapping outweighs its potential to act as a mitigation tool for surface water pollution. Here we present results from an on-going monitoring study at a trial agricultural wetland located in small a mixed-use catchment in Cumbria, UK. Estimates were made of CH₄, CO₂ and N₂O flux from the wetland surface using adapted floating static chambers, which were then directly compared with fluxes from an undisturbed riparian zone. Results indicate that while greenhouse gas flux from the wetland may be significant, the impacts of this may be greatly diminished when considering wetland size in relation to catchment area. As such, this increased understanding will be valuable when considering the implications of rural land use management for water quality improvement. This knowledge could also be applied to further enhancing our knowledge of gas regional/global gas emissions from freshwater systems, which at the moment are poorly constrained.